

REMARKS

The Claims

The non-elected claims, claims 1-23, 30-35, and 41-50, have been canceled. The remaining claims, claims 24-29 and 36-40, have been rejected.

Specifically, claims 24-29 and 36 stand rejected under 35 U.S.C. § 102(b) as allegedly anticipated by the Autumn et al. article from Nature, entitled: “Adhesive force of a single gecko foot-hair” (“Autumn et al.”) or by the Liang article from Solid State Sensor and Actuator Workshop, entitled “Adhesion Force Measurements on Single Gecko Setae” (“Liang et al.”). Claims 37-40 stand rejected under 35 U.S.C. § 103(a) as allegedly obvious over Autumn et al. or Liang et al.

The Standards of Anticipation and Obviousness

A claim is anticipated when a single prior art reference discloses all features recited in the claim.

Three criteria must be met to establish obviousness. First, the prior art must provide one of ordinary skill in the art with a suggestion or motivation to modify or combine the teachings of the references relied upon in rejecting the claims. Second, the prior art must provide one of ordinary skill in the art with a reasonable expectation of success. Third, the prior art, either alone or in combination, must teach or suggest each and every limitation of the rejected claims. The teaching or suggestion to make the claimed invention, as well as the reasonable expectation of success, must come from the prior art and not from Applicant’s disclosure. If any one of these criteria is not met, a case of obviousness is not established.

Applicant's Invention

Applicant's invention, in one configuration, is directed to a method of establishing an adhesive force. The method includes using a flexible beam to apply a seta to a surface with a force perpendicular to the surface so as to preload an adhesive force of the seta. The flexible beam is used to orient the seta parallel to the surface and to pull the seta with a force parallel to the surface. The seta may be pulled by the flexible beam at a velocity to increase the adhesive force exerted by the seta on the surface.

Applicant's invention, in another configuration, is directed to a method of establishing an adhesive force wherein a flexible beam is used to apply a plurality of protrusions on a supporting structure to a surface with a force perpendicular to the surface so as to preload an adhesive force of the protrusions. The flexible beam is used to orient the protrusions parallel to the surface and to pull the protrusions with a force parallel to the surface. The protrusions may be pulled by the flexible beam at a velocity to increase an adhesive force exerted by the protrusions on the surface.

The flexible beam provides for an improved device. It controls preload and orientation of the seta or protrusions. It produces the appropriate preload force while maintaining the desired parallel alignment of the seta or protrusions with the surface to which they are applied. (See Applicant's specification page 25, lns. 9-22).

The Cited Art

The Autumn et al. and Liang et al. articles disclose a technique for measuring the adhesive force of a single gecko foot-hair. The technique employs a MEMS sensor. The sensor is a micromachined, dual-axis piezoresistive sensor of the type described in U.S. Patent No. 5,959,200.

The cantilever sensor was fabricated on a single-crystalline silicon wafer. It had two independent force sensors, each with one predominant direction of compliance. The perpendicular or vertical sensor consisted of a thin triangular probe. The parallel force sensor was composed of four long slender ribs. A special 45° oblique ion implantation allowed piezoresistive and conductive regions to be implanted on both the parallel and perpendicular surfaces simultaneously. Forces applied to the tip of the sensor were resolved into these two orthogonal directions (parallel and perpendicular), and the forces were measured by the changes in resistance of the piezoresistors. The backside of the sensor was used to provide a smooth surface for setal adhesion. (See Autumn et al., page 684, col. 1, ln 31 to col. 2, ln. 9; Figure 1e; Linag et al., page 34, col. 2, ln. 32 to page 35, col. 1, ln. 13; Figure 4).

The setae was glued to the end of a # 2 insect pin or a rigid rod by an epoxy. (Autumn et al., page 684, col. 1, lns. 24-25; Liang et al. page 35, col. 1, lns. 25-27). Manipulation of the seta was done by means of the rigid pin. That is, for force measurements, the seta was brought into contact with the backside sensor surface by manipulation of the pin. (Autumn et al. page 683, col. 1, lns. 16-18; Liang et al. page 35, col. 1, ln. 27 to col. 2, lns. 2; page 35, col. 2, lns. 10-14; Figures 6, 7, and 9).

According to the data sheet provided by the examiner, a # 2 insert pin had a diameter of 0.45 millimeters (mm) and a length of approximately 3.8 centimeters (cm).

Applicant's Invention Is Not Anticipated Nor Would It Have Been Obvious

Applicant's invention is not anticipated by either Autumn et al. or Liang et al. Also, it would not have been obvious in view of these references. These references simply do not teach or suggest each and every limitation of the rejected claims.

Autumn et al. and Liang et al. do not disclose using a flexible beam to apply a seta to a surface with a force perpendicular to the surface so as to preload an adhesive force of the seta. Additionally, these references do not disclose using a flexible beam to orient the seta parallel to the surface. The flexible beam produces the appropriate preload force while maintaining a substantially parallel alignment of a seta or protrusions with a surface to which they may be applied.

Autumn et al. and Liang et al. also do not disclose using a flexible beam to pull the seta with a force parallel to the surface. Further, these references do not disclose using these techniques to manipulate a plurality of protrusions on a supporting structure. Moreover, these references neither teach nor suggest using a flexible beam to pull a seta or a plurality of protrusions at a velocity to increase an adhesive force exerted by a seta or protrusions on a surface.

As explained, for example, in the Liang et al.:

The pin is mounted on a computer-generated piezoelectric manipulator... and oriented so that the active surface of the seta is facing down. The seta is brought into contact with the sensor from above and a small downward preload is applied to initiate adhesion. The seta is then pulled away.

(Liang et al., page 35, col. 1, ln. 27 to col. 2, ln. 2). As such, “[t]he seta is brought into contact with the tip area of the sensor for simultaneous vertical and lateral force measurements.” (Liang et al. page 35, col. 2, lns. 10-12). The seta was thus brought into contact with the sensor by means of the pin.

The pin of Autumn et al. and Liang et al. is not a flexible beam that is used to apply a seta or a plurality of protrusions in such a way as to preload an adhesive force of the seta or protrusions and orient the seta or protrusions parallel to a surface. Rather, in Autumn et al. and Liang et al., the # 2 insect pin is a rigid rod that functioned as a rigid base for a single setae. (Autumn Declaration, paragraphs 9-11).

The forces generated by preloading a single gecko setae were much too small to cause any real deflection of the pin. That is, under any operational load or preload, the change in position or orientation of the pin with loading is negligible compared with its unloaded configuration. (Autumn Declaration, paragraphs 12-13).

The # 2 insect pin, as alleged by the examiner, did not have a diameter “which was well within the range of the . . . width and thickness of the ‘flexible beam’ of the claims.” According to Applicant’s specification, in one configuration, the flexible beam may have a thickness T of between about 0.1 and 0.3 mm. The diameter of a # 2 insect pin, however, is 0.45 mm. This is well outside the thickness range given in Applicant’s specification. In fact, the pin’s diameter is one and a half-times greater than that of a flexible beam having a thickness of 0.3 mm and four and a half-times greater than that of a flexible beam having a diameter of 0.1 mm.

Additionally, although Applicant’s flexible beam may be made of spring steel, material is only one factor in determining flexibility. Other factors are the beam’s length and radius. (Autumn Declaration, paragraph 12) As noted, the # 2 insect pin had a radius which was well outside the sample thickness range of Applicant’s specification.

The flexible beam of Applicant’s invention provides a new layer of compliance above a setae or an array of protrusions. The flexible beam yields proper preload of a setal array or protrusions while maintaining substantially parallel alignment of the setal array or protrusions with a surface. The flexible beam is designed such that under any operational load or preload, the loading of the beam acts to deflect it to a new position and orientation which improves engagement. (Autumn Declaration, paragraph 14).

As such, for at least these reasons, Applicant’s invention is not anticipated by nor would it have been obvious in view of Autumn et al. or Liang et al.

Additionally, since claims 24, 36, 37 and 38 are not anticipated by or obvious in view of the cited references, the claims depended therefrom cannot possibly be anticipated by or be obvious in view of these references.

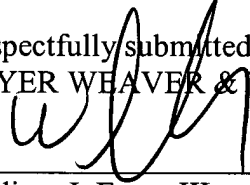
In view of the foregoing, it is submitted that all the claims are now in condition for allowance. Accordingly, allowance of the claims at the earliest possible date is requested.

If prosecution of this application can be assisted by telephone, the Examiner is requested to call Applicant's undersigned attorney at (510) 267-4106.

Please apply any other charges or credits to deposit account number 50-388 (Order No. LEWIP001).

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Respectfully submitted,
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